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Motivation and anxiety for dental treatment: Testing a self-determination theory model of oral self-care behaviour and dental clinic attendance

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Abstract The present study: (1) developed a Self-Regulation Questionnaire for Dental Treatment (SRQDT) based on Self-Determination Theory (SDT; Deci and Ryan, Psychol Inq 11:227–268, 2000), and (2) used it to test a SDT process model of oral self-care behaviours and dental clinic attendance. Patients' perceptions of autonomy supportive (relative to controlling) dental professionals were expected to be positively associated with patients' psychological needs satisfaction in treatment, which was expected to be positively related to relative autonomous motivation for dental treatment and perceived dental competence, and negatively related to anxiety for dental treatment. In turn, relative autonomous motivation for dental treatment and perceived dental competence were expected to be positively associated with oral self-care behaviours and dental clinic attendance. Anxiety for dental treatment was expected to be negatively related to dental clinic attendance and positively linked to putting off making a dental clinic appointment. Confirmatory factor analysis of the 5 factor SRQDT model fit the data very well, and a structural equation model supported the hypothesized process model.

Keywords Oral self-care · Self-determination theory · Dental clinic attendance

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Dental health care professionals recommend regular oral self-care behaviors for plaque removal because bacterial plaque plays an important role in the etiology of caries (i.e., tooth decay), gingivitis (i.e., inflammation and bleeding of gums), and periodontal disease (i.e., inflammation and breakdown in tooth attachment and bone structure) (Addy and Adriaens 1998; Axelsson 1998, 2006). It is generally recommended that patients brush their teeth twice per day using fluoridated toothpaste followed by flossing (Ashley et al. 1999; Brothwell et al. 1998; Chestnutt et al. 1998). Recommendations are less consistent regarding the duration of each brushing, but the literature indicates that 2 min is optimal for plaque removal among adults (Saxer et al. 1998; Van der Weijden et al. 1993). Unfortunately, actual self-care behaviors are far below the recommendations. Although different age groups vary, on average fewer than 50% of people use dental floss (Backdash 2000), 18–50% brush their teeth at most once per day (Backdash 2000; Chestnutt et al. 1998), and the literature indicates brushing time to be between 30 and 60 s among adults (Ramsey 2000).

Dental clinic attendance is another important behavior because it has clear positive associations with dental health

(Donaldson et al. 2008; Nuttall et al. 2001; Sheiham et al. 1985; Wisløff et al. 1995) and to be positively related to quality of life in general (McGrath and Bedi 2001). A committee of dentists has recommended that the maximum period between oral examinations for healthy adults should be 1 year (Health Education Authority 1996). In a recent Norwegian study among young adults aged 19–36 only 73% reported that they had been at the dental clinic during the last year (Halvari et al. in press). In the UK adults younger than 34 years old are the least likely to attend regular dental check-ups. Fewer than half of men and slightly more than half of women visit their dentist regularly (Nuttall et al. 2001). This young adult group is of special interest because they go through a transition period in which they leave the free public dental health care system in many countries when they are about 18–20 years of age and become responsible for their own care in a private system. During this period, regular use of dental health services decreases (Scheutz and Heidmann 2001).

Why is it that patients do not perform oral self-care behaviors as recommended and attend the dental clinic regularly? Herein we examine motivation and anxiety for treatment as possible factors among young adults.

Motivation and oral self-care

There has been very little theory-based research on the role of motivation in patient adherence to dental health care programs and to the prevention of oral disease. One exception is Ramsey (2000) who applied the control theory of self-regulation (Carver and Scheier 1998) to oral self-care behaviour. According to this theory people pursue goals with guidance from effectance-relevant feedback. Thus, professionals set realistic goals for the patients, ensuring that they are able to perform the required behaviours. Then, motivation is further influenced by the patients' knowledge that their behavior is being monitored and evaluated, and by possible incentives or rewards.

The use of evaluations and rewards to foster motivation, although it may represent approach-oriented motivation in control theory (Carver and Scheier 1998), has been found within the self-determination-theory tradition to represent external regulation (Reeve et al. 1999) and to diminish autonomous motivation (Deci and Ryan 2000). Thus, one could argue that, when a person's adherence to oral self-care behavior is contingent upon evaluative monitoring and rewards, it will be short-lived and will not persist when the person is no longer being monitored or rewarded (Deci et al. 1999; McCaul et al. 1992). Nonetheless, goals set for patients by dental professionals, rewards administered to motivate self-care behaviors, and evaluative monitoring are all frequently used in oral-health promotion programs. We

suggest that they may all contribute to controlled, as opposed to autonomous, motivation for the target behaviors and that this could explain why oral self-care behaviors are often not maintained over the long-term (Kay and Locker 1998; Lund and Kegeles 1984; McCaul et al. 1992). From the SDT perspective, effective oral self-care over the long-term would depend not on complying with demands for change but rather on accepting the regulation for change as one's own. In other words, it would require internalizing values and regulation for relevant behaviors and then integrating them with one's sense of self so they can become the basis for autonomous motivation (Deci and Ryan 2000; Williams et al. 1996).

According to SDT (Deci and Ryan 2000), when people are autonomously motivated, they experience a sense of choice and volition in the regulation of their behavior, and they feel as though the behavior emanates from their sense of self. In the psychological tradition of attribution theory, the behavior is said to have an internal perceived locus of causality (deCharms 1968). In contrast, when controlled in their motivation, people experience the behavior as being coerced or seduced by interpersonal or intrapsychic forces. Thus, the behavior has an external perceived locus of causality—that is, it is external to their sense of self. Substantial research attests to the qualitative advantages of autonomous relative to controlled motivation for effective health behavior change. For example, autonomous motivation for adherence to medication prescriptions and behavioral regimens has been found to promote more effective, persistent change, resulting in improved health (e.g., Williams et al. 2004). Further, evidence also suggests that autonomous motivation for dental treatment and change of oral health behaviors can be facilitated, resulting in improved oral health outcomes (Halvari and Halvari 2006). Thus, we predict that autonomous motivation for dental treatment will be important for oral self-care and oral health. The current research was designed, based on SDT (Deci and Ryan 2000), to develop a motivation questionnaire for dental treatment and to use it to examine autonomous motivation for dental treatment as well as anxiety for treatment as they related to oral self-care behaviors and dental clinic attendance.

Motivation for dental treatment: Theoretical basis

In a recent study (Halvari et al. in press), we examined motivation for oral self-care using the 4 types of extrinsic motivation proposed by SDT (Deci and Ryan 2000; Ryan and Connell 1989). We suggest that oral self-care and dental treatment are not enjoyable or intrinsically motivated but are in most cases extrinsically motivated. Thus, the regulation of such behaviors can range from external, to

introjected, identified, and integrated regulation, respectively (Ryan and Connell 1989). This continuum of regulations is now briefly described. The regulations are differentiated by the degree of endorsement or autonomy of the regulated behaviors. *External regulation* of dental treatment behaviors involves engaging in the behaviors in order to attain desired tangible rewards or to avoid threatened punishment. Examples are: visiting the dental clinic in order to avoid criticism from the dental professional, to get a reward, to avoid nagging from others, or to avoid a painful dental treatment in the future. Externally regulated dental treatment behaviors are controlled by specific external contingent consequences administered by other people and thus are not self-determined.

The next type of extrinsic motivation on the continuum is *introjected regulation*. With introjection the control of behavior comes from contingent consequences that are internal to and administered by individuals to themselves. Examples are to attain contingent self-worth (pride) or to avoid guilt, shame, and feeling bad about oneself (Deci and Ryan 2000). Introjection represents partial internalization because external regulations are taken in by people, but they are not assimilated or accepted as the individuals' own. Introjects about dental behaviors are experienced by people in terms of "having to do" the behaviors in order to feel like others regard them highly.

The third type of extrinsic motivation is *identified self-regulation,* which is present when people recognize and accept the underlying value of a behavior. The internalization process is fuller than with introjection so the regulated behaviors are more self-determined (Deci and Ryan 2000). Examples are: people who truly believe it is important to visit the dental clinic regularly for their own health and well-being. When behaviors are endorsed in the form of identifications, they are expected to be associated with higher commitment and better-maintained performance. The fourth and most self-determined type of extrinsically motivated behavior is called *integrated*. Its value and regulation have been fully integrated within the person's sense of self because the person has brought the behavior into a consistent and harmonious relation with the other goals, values, and needs that make up their core self. Accordingly, people experience less inner conflict because they experience the behavior as having its origin in their own interests, values, and feelings. An example of integrated regulation would be parents who value and pursue visits to the dental clinic regularly for their own health, as well as to model it for their children. "As such, what was initially external regulation will have been fully transformed into self-regulation, and the result is self-determined extrinsic motivation" (Deci and Ryan 2000, p. 236). Among these four types of extrinsic motivation, the sum of external and introjected regulations is termed

controlled motivation in the literature (Deci and Ryan 2000), whereas the sum of identified and integrated self-regulation is termed autonomous motivation.

Autonomous and controlled behavioral regulations are all intentional or motivated. In contrast, *amotivation* is a state in which people lack the intention to behave so it is characterized by a complete absence of behavioral self-determination. People are amotivated because they either perceive that no behavior would reliably lead to desired outcomes or because they believe they could not successfully effectuate a behavior that would lead to the outcome (Deci and Ryan 2000).

In the present study, the four types of behavioral regulations described, plus amotivation, were used to develop the Self-Regulation Questionnaire for Dental Treatment.

Anxiety for dental treatment

Dental anxiety is defined as fear of dental treatment or certain aspects of it (ter Horst and de Wit 1993). Research indicates that dental anxiety is a major reason for many young people to put off dental appointments (Skaret et al. 1999). It is well accepted in the literature that dental anxiety is related to avoidance of dental care or inversely related to dental clinic attendance in such populations as young adults (Haugejorden and Klock 2000; Quetish Taani 2002; Scheutz and Heidmann 2001), adults (Donaldson et al. 2008; Nicolas et al. 2007; Pohjola et al. 2008; Viinikangas et al. 2007), adult patients (Heaton et al. 2007; Woolgrove and Cumberbatch 1986), and middle-aged and elderly women (Högglin et al. 2000). Dental anxiety may be a part of a complex pattern of factors that relates to dental attendance because other research has shown that negative dentist-patient interpersonal relationship, anticipation of pain, and lack of feeling of control are major explanatory factors for both dental anxiety and irregular dental attendance (Logan et al. 1991; Milgrom et al. 1992; Moore et al. 1996; Nuttall et al. 2001; Rouse and Hamilton 1990; Skaret et al. 2000). Dental anxiety is often associated with anticipated pain (Kleinknecht and Bernstein 1978; Wardle 1982) and the need for more invasive treatment when patients have to attend the dentist (Milgrom et al. 1995). However, these studies do not explain why many patients who expect to experience pain do not report anxiety (Wardle 1982). A study by Bernstein et al. (1979) may shed some light on this question because perceived negative dentist behavior was a factor for 50% of the high-anxiety group, with most of these patients not citing pain as a reason for their reactions to dentistry. Lack of empathic behavior on the part of dentists may be the cause of negative reactions because the dentists were considered impersonal, uncaring, uninterested, or cold. Of course, this

relation may be bi-directional, because severe dental anxiety among patients may reduce the quality of the interpersonal relationship with their dentists, which could negatively affect the quality of dental care delivered (Eli 1993).

Another factor related to dental anxiety may be the lack of patient involvement in their treatment. Many people feel uninvolved in their own dental treatment, reporting that they want to be more involved in planning their treatment and its costs and knowing what the dentist is going to do and why. Half of the UK population definitely agreed with the statement "I would like to be given an estimate without commitment," which suggests that people want to have the option of leaving the dental clinic untreated in order to consider the treatment proposal. These findings indicate that many patients feel that they are not in control of what happens to them when they attend dental clinics (Nuttall et al. 2001). Various studies attest to the importance of a supportive social-clinic context, characterized by an informal and empathic relationship between the dentist and patient, and patient involvement in treatment, as these factors have predicted both patients' attendance at a 6-month dental follow-up visit and their dental health improvements (Sandell et al. 1994). Research has also shown that effective dentist-patient communication had a positive effect on dental attendance at a 4-year follow-up (Dailey et al. 2001). Finally, research by Corah (1988) indicated that patient satisfaction and anxiety reduction can be promoted by a social treatment context in which dentists' behaviors convey empathy, friendliness, a calm and competent image, and moral support, accompanied by an explicit promise to prevent pain. In sum, this research can be interpreted as indicating that an autonomy-supportive (relative to controlling) dental clinic context is important for patients' need satisfaction in treatment, anxiety reduction, and facilitation of oral health-related behaviors and oral health.

Need satisfaction in treatment and anxiety for dental treatment

The evidence reviewed above indicates that anxiety for dental treatment could be included as a "mid-level" construct in the SDT process model of behavior change along with autonomous motivation for treatment and perceived dental competence, between psychological need satisfaction and important dental behaviors. In other words, dentist behaviors could lead to decreased anxiety by facilitating satisfaction of the basic psychological needs. Specifically, (1) empathy, friendliness, an informal relationship, and moral support may fulfil patients' social relatedness need (see also, Baumeister and Leary 1995); (2) patient

involvement in treatment planning and being able to consider a treatment proposal before it is implemented may increase their inner experience of choice and fulfil their need for autonomy (see also, deCharms 1968); and (3) effective dentist-patient communication about what the dentist is going to do and why, a calm and competent image, and successful prevention of pain are all likely to allow the patient to feel more engaged in and accepting of the process and thus more competent as a dental patient, which may help satisfy their need for competence (see also, White 1959). Thus, interpreting the research on anxiety reduction in dental treatment in terms of SDT, satisfaction of all the three psychological needs could be promoted when dentists behave in the ways outlined above and need satisfaction would be predicted to be associated with low anxiety for treatment, which is expected to be associated with high dental clinic attendance and lessened putting off of dental appointments. This reasoning is indirectly supported by a study on autonomy support, distress (including anxiety), and medication adherence among HIV+ patients (Kennedy et al. 2004).

Autonomy support at the clinic and patient need satisfaction in treatment

Autonomy support has been shown to facilitate more self-determined regulation for uninteresting activities (Deci et al. 1994). Autonomy-supportive contexts are defined as "ones in which significant others offer choice, provide a meaningful rationale, minimize pressure, and acknowledge the target individual's feelings and perspectives" (Williams et al. 1996, p. 117). Why does autonomy support facilitate uninteresting activities becoming more autonomously motivated, self-initiated, and maintained? SDT argues that the process of internalization toward more self-determined types of motivation arise out of psychological need satisfaction (Deci and Ryan 1985, 2000; Ryan and Deci 2000). Conversely, controlling social contexts (i.e., those low in autonomy support) are hypothesized to undermine psychological needs satisfaction and thus impair internalization. SDT further claims that none of the three needs can be threatened, thwarted, or neglected without having significant negative consequences for effective behavior change and healthy psychological functioning (Deci and Ryan 2000). Many experimental and field studies in areas other than dentistry now attests to the qualitative advantage of autonomy support and the disadvantage of controlling styles (see Deci and Ryan 2000, for a review of the literature). A recent oral-health study indicate that a controlling clinic style (relative to an autonomy-supportive one) was associated with low need satisfaction in treatment among patients, which was linked

to low perceived dental competence and low autonomous motivation for oral self-care, and low scores on self-rated oral health, oral self-care behaviors, and effort/quality of oral self-care (Halvari et al. in press).

Thus, in testing the SDT process model, basic need satisfaction will be used as a mediating variable between perceived dental-clinic autonomy support (relative to control) and the variables relative autonomous motivation, anxiety for dental treatment, and perceived dental competence. Finally, oral self-care behaviors and dental attendance are modelled as outcomes.

The self-determination theory process model

SDT argues that autonomy-supportive (relative to controlling) dental-care contexts will facilitate satisfaction of patients' basic psychological needs in relation to dental care, which would facilitate both autonomous motivation and perceived competence for dental care, both of which are critical prerequisites for initiation and long-term change of dental-health behavior. Research supports the importance of autonomy-supportive patient care for (1) increases in autonomous motivation and perceived competence for attendance at a weight-loss program, which, in turn, affected higher attendance and subsequent long-term maintained weight loss (Williams et al. 1996); (2) facilitating autonomous motivation for taking medications, which in turn led to patients' medication adherence (Williams et al. 1998b); and (3) enhancement of autonomous motivation and perceived competence for diabetes self-management and, in turn, improved glycemic control for patients with Type 2 diabetes (Williams et al. 2004). In the area of dental-health care, a recent field experiment in a clinic setting, showed that, relative to standard dental care, an autonomy-supportive informational intervention increased patients' perceived dental competence and autonomous motivation for dental treatment over a 7-month period, which decreased plaque and gingivitis over the same time period, and resulted in better dental self-care behavior and more positive dental health attitudes and affect at the end of the time period (Halvari and Halvari 2006).

SDT seems to have much in common with health promotion strategies, which include both disease prevention and health promotion (WHO 1986). The aims of health promotion are to strengthen the positive factors for health both at the individual and community level. According to WHO, this includes social and competence support enabling individuals and groups to identify their expectations and goals, to satisfy their needs, to develop their knowledge and competence, and to be actively involved in cooperation with dental-care professionals, so that they willingly initiate healthy activities for their own well-being (WHO 1986). Due to this, we included a measure of oral health promotion behavior to make possible a study of its relations with SDT-related variables. Oral health promotion behavior is defined as knowing the causes of oral diseases (conceptual knowledge), the cognitive activity of knowing how to use it, and overtly using it (procedural knowledge) in order to prevent sickness and promote and maintain one's own health (Anderson 1990).

In the current study, in line with the theoretical reasoning and research presented, we tested the psychometric properties of a new SDT-based measure with 5 motivational subscales for dental treatment. In turn, we used it to test a SDT process model for oral self-care and dental attendance, hypothesizing that: (1) an autonomy-supporting (relative to controlling) style provided by dental hygienists or dentists would be positively correlated with patient psychological needs satisfaction in treatment; (2) needs satisfaction in treatment would be positively associated with patients' relative autonomous motivation for treatment and perceived dental competence, and negatively linked to anxiety for treatment; (3) there would be a positive path from relative autonomous motivation to perceived dental competence; (4) both relative autonomous motivation and perceived competence would be positively associated with oral self-care behaviors and dental clinic attendance; and (5) anxiety for treatment would be negatively associated with dental clinic attendance and positively related to putting off making a dental clinic appointment.

In hypothesis 3, relative autonomous motivation is modelled to lead to perceived competence (Kennedy et al. 2004; Williams et al. 2006). The empirical literature is unclear about this sequencing because other research indicates the opposite, namely, that perceived competence affect autonomous motivation (Halvari and Halvari 2006; Palmeira et al. 2007; Teixeira et al. 2006). It is probable that this relation is bi-directional, so we tested the alternative in the model, namely, that perceived dental competence led to relative autonomous motivation.

Method

Participants

Students at the University of Oslo and the Police University College of Oslo were contacted in a university setting and asked if they would participate in the survey. They were informed that the aim of the study was to better understand issues related to dental clinical experiences, oral self-care, and health. After giving informed consent some of the students responded to the questionnaire

immediately. Due to commitments most of the students took the questionnaires with them and delivered them shortly later or returned them by mail (a stamped envelope was provided). The participants were police students and students of psychology, educational sciences, philosophy, sociology, history, medicine, music, statistics, pharmacy, mathematics, and physics. No incentives were offered for participation. A total of 357 questionnaires were handed out and 208 were returned (58.3%). Participants' ages ranged from 20 to 36 years ($M = 25.4$, SD $= 3.5$). More females than males responded to the questionnaire (females $= 76.9\%$).

The participants' answers on several questions related to their dental history and clinic attendance indicated that they were relatively healthy. Self-reported answers to questions about fillings in their teeth were low (total $M = 3.13$, SD $= 4.06$), with zero fillings being reported by 32.3%, 1–4 fillings by 47.6%, and 5–22 fillings by 20.1% of the participants. Of the participants, 68.3% reported that they had been at the dental clinic during the last year and 89.9% the last 2–3 years. Participants were asked to recall their last visit to their dental professional and report whether this person was a dental hygienist or a dentist. Of the participants, 91.3% recalled their dentist.

Assessment of perceived autonomy support and control at the clinic

Perceived autonomy support was measured with the 6-item short version of the Health-Care Climate Questionnaire (HCCQ; Williams et al. 1996). Before the participants responded to the items in the HCCQ they were introduced to their own clinic context by the following instructions and questions: "Think back to your last visit to a dental hygienist or dentist. It is important that you try to think about the treatment and your experiences with this dental professional". This introduction was followed by 6 questions on who this dental professional was (a dental hygienist or a dentist, a female or a male), the number of visits to this dental professional, type of clinic (private or public), time since last visit, and number of visits during the last 2 years. "If you answered "dental hygienist" in question 1, please have this person in mind and answer the following questions with reference to your dental hygienist. However, if you answered "dentist" in question 1, please answer the following questions with reference to your dentist". The HCCQ assesses participants' perceptions of the degree to which their dental professional were autonomy-supportive at the clinic. They responded to 6 items on a 1 (strongly disagree) to 7 (strongly agree) scale. A sample item is: "I feel that my dental professional has provided me choices and options". Recently, this scale was tested in Norway among education students (Halvari et al.

2009), patients in rehabilitation after heart disease (Svarstad 2007), patients in rehabilitation with the intention of going back to work after long-term diverse illnesses (Utistog 2007), elite athletes (Solberg and Halvari 2009), and young adults in dental treatment (Halvari et al. in press). The results of these studies indicated good internal consistency and validity for the HCCQ.

Perceived Controllingness was measured with the Perceived Controlling Style at the Dental Clinic Questionnaire (PCSDCQ; Halvari et al. in press). The 14 items are intended to measure clinic conditions that may: (1) Threaten satisfaction of the need for autonomy, which means that people experience less choice and believe their actions are other-initiated (deCharms 1968). Sample item: "I feel that the dental professional will do what he/she wants and not listen to me when I sit in the chair". (2) Threaten fulfillment of the need for competence, which means that people experience that they are *not* capable of acting effectively to attain desired results (White 1959). Sample item: "When my teeth are being examined, I feel underestimated and humiliated." (3) Threaten fulfillment of the relatedness need which involves an experience of *not* being safely attached to and understood by others (Baumeister and Leary 1995). Sample item: "My dental professional does not see me as a person, he/she sees only the teeth." Participants responded to the items on a 1 (strongly disagree) to 7 (strongly agree) scale. A maximum likelihood factor analysis with varimax rotation of the 6 autonomy support and the 14 controlling items yielded two factors almost identical with the results from a previous study (Halvari et al. in press). Total explained variance was 53%. The first factor comprised controlling items (eigenvalue after rotation: 6.61; explained variance: 33.0%) and the second factor comprised autonomy-support items (eigenvalue after rotation: 3.98; explained variance: 20.0%). Thus, 6 items for autonomy support and 14 items for a controlling clinic style were averaged for each factor (see Halvari et al. in press, for a complete description of items in the PCSDCQ).

Assessment of basic psychological needs at the clinic

Basic psychological needs satisfaction was measured with the Basic Psychological Need Satisfaction in Exercise Scale (Vlachopoulos and Michailidou 2006), adapted to the dental clinic domain. It consists of 12 items intended to measure satisfaction of the 3 basic needs for competence, autonomy, and social relatedness with 4 items each. Participants responded to the items following this stem: "When you are in dental treatment, how untrue or true are the following statements?" Sample items are: "I feel that I associate with my dental professional in a friendly/pleasant way" (relatedness need), "I feel that I can manage the

requirements of my dental treatment" (competence need), and "I feel that the treatment or examination of my teeth is definitely an expression of my wishes" (autonomy need). The participants indicated how true each item was for them on a 7-point scale varying from 1 (*not at all true*) to 7 (*very true*).

Because SDT (Deci and Ryan 2000) has postulated the three needs, confirmatory factor analyses were performed to test the scales psychometric properties. The *a priori* model with 12 items yielded a good fit for the CFI, IFI, and SRMR [χ^2 (*df* = 51, *N* = 208) = 177.38, *p* < .001; CFI = .98; IFI = .98; RMSEA = .109; SRMR = .061], but a RMSEA above the recommended value (Hu and Bentler 1999). We omitted 3 items with the highest error uniqueness correlations (i.e., one item from each of the three sub-scales of relatedness, competence, and autonomy needs, respectively). The final model of the 9-item Basic Need Satisfaction in Dental Treatment Questionnaire yielded a very good fit [χ^2 (*df* = 24, *N* = 208) = 42.70, *p* = .011; CFI = .99; IFI = .99; RMSEA = .061; SRMR = .039]. See "Appendix" for the items with factor loadings.

The items were averaged within subscales to reflect the needs for autonomy, competence, and relatedness. Recently, this scale was tested in Norway among elderly people participating in a randomized controlled trial on SDT and physical activity (Solberg et al. 2009), and yielded acceptable reliability and validity indications.

Development of the Self-Regulation Questionnaire for Dental Treatment

The initial test-version of the Self-Regulation Questionnaire for Dental Treatment (SRQDT) comprised 54 items. These items were formulated after inspections of items in: (1) original versions of the Self-Regulation Questionnaire (Ryan and Connell 1989) used in different domains (e.g., academic, exercise); (2) the Treatment Self-Regulation Questionnaire, which was first used for weight loss of morbidly obese patients (Williams et al. 1996) and later used for glucose control among patients with diabetes (Williams et al. 1998a) and smoking cessation (Williams et al. 1999); and the Regulation of Eating Behavior Scale developed by Pelletier et al. (2004). Before the participants responded to the questions they were encouraged to continue thinking back to their last visit to their dental professional. Participants responded to the items following two stems: "I decided to enter treatment at my dental professional because: …" and "If I remain in treatment it will probably be because:", using a 7-point scale ranging from 1 (*not true at all*) to 7 (*very true*). The final set of items that emerged appears in Table 1. For details regarding the analyses see the result section. The items and

their meaning correspond well to SDT (Deci and Ryan 2000) and the previous versions of the Self-Regulation Questionnaire used in other domains. For each of the 5 motivational regulations shown in Table 1, the items were averaged within the subscale.

According to SDT (Deci and Ryan 2000), an *autonomous motivation* score was calculated by summing integrated and identified regulations, and a *controlled motivation* score was estimated by summing introjected and external regulations. Finally, a Relative Autonomy Index was calculated by the following formula: RAI = [(Integrated X 2 + Identified X 1) + (Introjected $X - 1$ + External $X - 2$)].

Assessment of perceived dental competence

Perceived dental competence was measured with the Perceived Competence Scale (PCS), adapted to the dental domain from scales used in diabetes self-care (Williams et al. 1998a) and learning among medical students (Williams and Deci 1996). Students responded to 4 items on a 1 (*strongly disagree*) to 7 (*strongly agree*) scale. Each item asked the students how skilled or effective they felt in carrying out their dental care. An example item is: "I feel confident in my ability to manage my dental care". The items were averaged to reflect perceived dental competence. This scale has been tested in Norway among upper secondary school students (Bagøien and Halvari 2005), education students (Halvari et al. 2009), and participants in a study of dental home care among young adults (Halvari et al. in press). The results indicated good internal consistency and validity for the Perceived Competence Scale.

Assessment of anxiety for dental treatment

Anxiety for dental treatment was measured by the Dental Anxiety Scale (Corah 1969). Four items are intended to measure anxiety associated with anticipation of dental treatment. An example item is: "When you are waiting in the dental professional's office for your turn in the chair, how do you feel?" Participants responded on a 5-point scale ranging from 1 (*Relaxed*), over 2 (*A little uneasy*), 3 (*Tense*), 4 (*Anxious*), to 5 (*So anxious that I sometimes break out in a sweat or almost feel physically sick*). The items were averaged to reflect anxiety for dental treatment. The Dental Anxiety Scale has been criticized for not covering the anaesthetic injection part of dental fear (Schuurs and Hoogstraten 1993) and due to different response alternatives for items (Humphris et al. 1995). However, a Modified Dental Anxiety Scale (Humphris et al. 1995) did not perform better than the original Dental Anxiety Scale (Corah 1969) among 25-year-old Norwegians in relation to not visiting a dentist (Haugejorden and Klock 2000). In that

Table 1 Self-regulation for dental treatment items, their primary and secondary loadings from exploratory factor analysis (in italics), and loadings from confirmatory factor analysis in bold and below the loadings in italics

I decided to enter treatment at my dental professional because	Regulations (factors)				
	Inte	Ident	Intro	Ext	Amot
1. It seems like part of who I am to do it	.83	.18			
2. It has become an important habit for me	.90	.19			
3. It has become a well-established part of my life	.92				−.14
	.95				
4. Going to treatment has become a natural habit for me*	.94				−.15
	.98				
5. It feels quite natural for me to continue*	.76	.18			
6. It is a well-established habit in me*	.94	.12			
	.97				
7. It is important to me personally	.42	.67			
8. I feel it is important for me personally to do it		.72	.37		
		.84			
9. It has great personal significance for me*		.65	.40		
		.88			
10. I experience it as personally important*		.63	.49		
		.90			
11. I feel guilt in relation to my teeth, and I have to do something about it	−.18		.60		
12. My conscience will bother me if I don't do it	.20		.72		
13. I'll feel bad about myself if I don't do it*			.69	.25	
			.82		
14. I feel a pressure inside me that compels me to do it*			.71	.14	
15. I'll feel proud of myself if I continue*		.20	.63		
16. I'll be dissatisfied with myself if I don't do it*		.18	.73		
			.83		
17. My conscience will be relieved if I do it*		.11	.86		
			.84		
18. I don't want my dental professional to tell me how badly I care for my teeth			.41	.50	
				.67	
19. I don't want my dental professional to be dissatisfied with me*				.72	.11
				.73	
20. I don't want my dental professional to be irritated at me*			.20	.61	
				.87	
21. I don't really know, I don't think treatment will change anything for me		−.23			.68
					.72
22. I really don't know whether it will mean anything to me				.11	.60
23. I'm not sure any longer, I don't think it will matter whether I continue or not*				.13	.70
24. I don't know, I don't think it will change anything*				−.04	.71
					.77
25. I really don't know if I want to spend more time on my teeth, and whether it would help me*	−.13				.51
					.72
26. Previously, I had good reasons to go to treatment, but now I wonder if it has any meaning for me*	−.18				.62
Eigenvalue	5.28	2.16	4.37	1.31	2.71
Explained variance, R^2 (%)	20.30	8.30	16.80	5.10	10.40

$N = 208$. The stem for * items is: "If I remain in treatment it will probably be because:" *Inte* integrated, *Ident* identified, *Intro* introjection, *Ext* external, *Amot* amotivation

Norwegian study the Dental Anxiety Scale showed high internal consistency. Thus, we used the 1969-version of the scale in the present study.

Assessment of oral self-care and health behaviors

Dental behaviors were measured with questions that relate to effort and quality of dental home-care, use of dental floss, tooth-brushing, use of fluoride, oral disease prevention and health promotion behavior, clinic attendance, and putting off making dental appointments due to fear or worry.

Effort and quality of dental home-care was measured by 7 items adapted to dental care from Kuvaas (2006a, b). Two example items are: "I brush my teeth as well as possible" and "I work very hard in the care of my teeth". Participants responded on a 7-point scale ranging from 1 (*does not suit me at all*) to 7 (*suits me very well*).

Use of dental floss was measured by the following 4 questions: (1) "Do you use dental floss?" Participants answered: 1 (*No*) or 2 (*Yes*). (2) "I use dental floss vigorously every day." Participants responded on a 7-point scale: 1 (*not at all true*) to 7 (*very true*). (3) "How often do you use dental floss in the areas between your teeth?" Responses were: 1 (*never*), 2 (*once per 14 day*), 3 (*once a week*), 4 (*every second day*), and 5 (*daily*). (4) "I am very determined to use dental floss every day." Responses were: 1 (*not at all true*) to 7 (*very true*). Because different scales were used here, the four "dental floss" scores were standardized before they were added to form the total score.

Tooth-brushing was measured by the following 3 questions: (1) "I brush my teeth vigorously two times or more every day". Responses were: 1 (*not at all true*) to 7 (*very true*). (2) "How often do you brush your teeth?" Responses were: 1 (*quite seldom*), 2 (*not every day*), 3 (*once a day*), 4 (*twice a day*), and 5 (*three times a day or more*). (3) "I am very determined to brush my teeth twice a day or more." Responses were: 1 (*not at all true*) to 7 (*very true*). Because the scales used here are slightly different, the three scores were standardized before they were added to form the total score.

Use of Fluoride was measured by 2 questions: (1) "How often do you use mouth rinse with fluoride or fluoride tablets?" Responses were: 1 (*never*), 2 (*once per 14 day*), 3 (*once a week*), 4 (*every second day*), and 5 (*daily*). (2) "I use mouth rinse with fluoride or fluoride tablets every day." Responses were: 1 (*not at all true*) to 7 (*very true*). Because the scales used were slightly different, the two scores were standardized before they were added to form the total score.

Oral Health Promotion Behavior (OHPB) was measured by the following four items: "I have knowledge about caries development and:" (1) "I *use* this knowledge in order to promote my dental health" and (2) "I *can* use this knowledge to promote my dental health". "I have

knowledge about gingival inflammation and its development" and: (3) "I *use* this knowledge in order to promote my dental health" and (4) "I *can* use this knowledge to promote my dental health". Responses were: 1 (*not true at all*) to 7 (*very true*). The items were averaged to reflect oral health promotion behavior.

Estimating dental behavior total

Because the three measures of dental floss use, tooth-brushing, and use of fluoride were significantly positively correlated (see Table 5), we standardized each variable, because somewhat different scales were used, and added them to form the score for "Dental Behavior Total" (Cronbach's alpha = .86; for information on reliability for other measures, see Table 3).

Assessment of clinic attendance and putting off making a dental appointment

Clinic attendance was measured with this question: "How long time has it been since your last visit at a dental clinic?" Responses were: 1 (*more than 7 years ago*), 2 (*6–7 years ago*), 3 (*4–5 years ago*), 4 (*2–3 years ago*), 5 (*1–2 years ago*), and 6 (*less than a year*).

The measure of putting off making a dental appointment is from the Dental Fear Survey (Milgrom et al. 1995). Its focus is on avoidance of dentistry and consists of the following 2 questions: "Has fear or worry ever caused you to put off making an appointment (1) with a dental hygienist? (2) with a dentist?" Responses were: 1 (*never*), 2 (*once or twice*), 3 (*a few times*), 4 (*often*), and 5 (*nearly everytime*). The items were averaged to reflect putting off making a dental appointment due to fear/worry.

Gender was indicated by 1 (*female*) and 2 (*male*) and age by years.

Results

Factor analysis of the self-regulation of dental treatment items

Preliminary analyses of item scores yielded some non-normal distributions ($-2.0 >$ Skewness > 2.0), some items with low convergent factor loadings ($<.50$), and some items with low discriminate validity attributes (difference between primary and secondary loading $< .10$). These items were removed, except item number 18 in Table 1 which was kept due to the importance of having at least 3 items for each regulation. The results of an exploratory maximum-likelihood factor analysis of the 26 remaining items, with varimax rotation, appears in Table 1 and reveals a five-factor solution. Total explained variance was 60.9%.

Because SDT (Deci and Ryan 2000) predicted the 5 types of regulations, a confirmatory factor analysis was performed to reduce the 26 items to 15, with 3 items for each of the 5 types of regulation. We used the chi-square likelihood ratio (χ^2), the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI), the Incremental Fit Index (IFI), and the standardized root-mean-square residual (SRMR) as model fit indices, as recommended for evaluating model fit in covariance structure analyses (Bollen 1989; Hu and Bentler 1999). A good fit should have a value close to or lower than .06 for the RMSEA, a value close to or lower than .08 for the SRMR, and a value close to or higher than .95 for the CFI and IFI. Hu and Bentler (1999) compared all fit indices and found that the SRMR is most sensitive to misspecification in both simple and complex models and less sensitive to sample size and violations of distributional assumptions. In the evaluation of model fit we relied more on the values for SRMR and CFI than the RMSEA because the latter tends to over-reject true-population models at small sample size (<250) and thus is less preferable for the sample size of 208 in the present study (Hu and Bentler 1999).

The a priori model with all 26 items yielded a reasonably good fit for the CFI, IFI, and SRMR [χ^2 ($df = 80$, $N = 208$) $= 235.20$, $p < .001$; CFI $= .93$; IFI $= .93$; RMSEA $= .097$; SRMR $= .070$]. In the process of reducing the number of items from 26 to 15, we examined the modification indices and looked for items with high error uniqueness correlations. We omitted items with indicators that had both the highest error values and the lowest factor loadings, and then those with sizable error correlation magnitude and low factor loadings, until 15 items remained. In addition, modification indices suggested adding error covariances between an introjection item and respectively one external item (positive), one identified item (negative), and one integrated item (negative), as well as between one amotivation item and one identified item (negative). These suggestions were evaluated as theoretically meaningful due to the expected simplex-like pattern of correlations between the regulation subscales (Deci and Ryan 2000). The final model of the 15-item Self-

Regulation of Dental Treatment Questionnaire yielded a good fit [χ^2 ($df = 80$, $N = 208$) $= 180.48$, $p < .001$; CFI $= .95$; IFI $= .95$; RMSEA $= .078$; SRMR $= .071$]. The factor loadings for items in the final confirmatory factor analysis are presented in Table 1 (loadings in bold). The 15-item scale was used in subsequent analyses.

Self-regulation continuum

The results indicate very good and acceptable levels of internal consistency for the five types of regulation (see Table 2). The correlations between the five regulation types showed a very good simplex-like pattern, with regulation types closer to each other correlating more positively with each other, and those farther from each other correlating less positively or more negatively. According to SDT (Deci and Ryan 2000) this provides the basis for reducing the data for the 4 types of regulation (not including amotivation, which is a lack of regulation) by calculating a Relative Autonomy Index (see formula in "Method" section).

Descriptive statistics and reliability

Table 3 shows the means, standard deviations, ranges, skewness values, and reliabilities for all variables. Relatively high levels of internal consistency (Cronbach's alpha) emerged. Skewness values are acceptable according to criteria set in the literature ($-2.0 < SKEW < 2.0$), except the value for "putting off making a dental appointment," which is slightly above the margin (Muthen and Kaplan 1985). Due to the good reliability (see Table 3), and the reduction in skewness after log transformation of this variable, we kept the variable in subsequent analyses.

Correlations between motivational regulations and other study variables

Additional support for the SDT self-regulation continuum can be found in the correlations (Table 4) between the 5 subscales and, respectively, SDT variables and health-

Table 2 Descriptive statistics for self-regulation for dental treatment subscales, Pearson correlations among them, and reliability coefficients [Cronbach's alphas in brackets] on the diagonal for 3 item subscales ($N = 208$)

Regulation	M	SD	Obs. range	Skew	1	2	3	4	5
1. Integrated	3.73	2.00	1.0–7.0	0.22	[.96]				
2. Identified	3.78	1.75	1.0–7.0	0.20	.45***	[.89]			
3. Introjected	3.54	1.60	1.0–7.0	0.33	.16*	.60***	[.84]		
4. External	1.75	0.88	1.0–5.7	1.44	.00	.20**	.39***	[.70]	
5. Amotivated	1.92	1.01	1.0–5.3	1.19	−.25***	−.29***	−.14*	.08	[.68]

* $p < .05$; ** $p < .01$; *** $p < .001$ (two-tailed tests)

Table 3 Descriptive statistics for social contextual, motivational, and dental behavior variables (N = 208)

Variables	M	SD	Obs. range	Skew	Cron-bachs alpha
Autonomy-supporting style	4.78	1.24	2.0–7.0	−0.15	.89
Controlling style	2.00	1.05	1.0–6.6	1.36	.93
Competence need	4.67	1.24	1.0–7.0	−0.34	.75
Autonomy need	5.08	1.25	2.0–7.0	−0.22	.88
Social-relatedness need	5.27	1.38	1.0–7.0	−0.57	.88
Total needs satisfaction	5.01	1.12	2.0–7.0	−0.34	.91
Perceived dental competence	5.05	1.25	1.3–7.0	−0.49	.89
Relative Autonomy Index	4.72	5.00	−9.3–16.0	0.25	–
Autonomous motivation	3.75	1.60	1.0–7.0	0.16	.88
Controlled motivation	2.64	1.05	1.0–5.5	0.48	.77
Amotivation	1.92	1.01	1.0–5.3	1.19	.68
Anxiety for dental treatment	2.30	0.91	1.0–5.0	0.65	.87
Effort & quality of dental home-care	4.47	1.34	1.0–7.0	−0.21	.93
Use of dental floss (STD sum score)	0.00	0.91	−1.3–1.3	−0.02	.93
Teeth brushing (STD sum score)	0.00	0.89	−2.8–1.3	−1.36	.89
Fluor use (STD sum score)	0.00	0.99	−0.9–1.5	0.58	.95
Dental behavior; total (STD sum score)	0.00	0.71	−1.6–1.3	−0.24	.86
Dental health promotive behavior	4.34	1.41	1.0–7.0	−0.19	.85
Clinic attendance	4.93	1.17	1.0–6.0	−1.12	–
Putting off making a dental appointment (POMDA) due to fear or worry	1.40	0.88	1.0–5.0	2.59	.87
POMDA; LN	0.20	0.41	0.0–1.6	2.10	.87
Gender	1.23	0.42	1.0–2.0	1.29	–
Age	25.4	3.5	20–36	−0.86	–

STD standardized sum score, *LN* log transformed

related variables. To illustrate: Integrated regulation, the most self-determined type of extrinsic motivation, are significantly positively correlated with autonomy support, needs satisfaction, perceived dental competence, and all health-related measures, and was negatively correlated with anxiety for dental treatment and "putting off making a dental appointment due to fear/worry". Conversely, the opposite pattern of correlations emerged for amotivation, except for anxiety for dental treatment which is nonsignificant, and the marginally significant correlations for teeth brushing and fluoride use. Regarding identified, introjection, and extrinsic regulations the correlations with the study variables were weaker, as would be expected.

Hypotheses testing

Theoretical model

The hypotheses concerned the relations among variables, including mediated processes that appear in Fig. 1. The relevant results begin with a correlation matrix (Table 5) among all variables. We expected that an autonomy-supporting style would be positively correlated and a controlling style would be negatively correlated with need satisfaction. Next, need satisfaction was expected to be

positively associated with perceived dental competence and relative autonomous motivation for treatment (RAI) and negatively associated with anxiety for treatment. Finally, both perceived dental competence and RAI were expected to be positively associated with effort and quality of dental home-care, oral self-care behaviors, and clinic attendance; and effort and quality of dental home-care was expected to be positively correlated with oral self-care behaviors. Anxiety for dental treatment was expected to be negatively correlated with dental attendance and positively linked to putting off making a dental appointment. The zero order correlations are all in line with these expectations.

Structural equation modelling

We examined the SDT process model (Fig. 1) using structural equation modelling (LISREL). Due to the large number of indicators (items) in relation to the sample size, the SDT process model was tested on the basis of a combination of observed variables and latent variables. The latent variables were represented by items having the highest factor loadings and the lowest error correlation magnitudes for each construct (see factor loadings in

Table 4 Pearson correlations between 5 self-regulations of dental treatment, other SDT-relevant variables and dental behaviors ($N = 208$)

Variables	Integrated	Identified	Introjection	External	Amotivation
Autonomy-supporting style	.26***	.01	−.10	−.16*	−.29***
Controlling style	−.11	.16*	.29***	.31***	.27***
Competence need	.50***	.23***	−.12	−.12	−.25***
Autonomy need	.38***	.11	−.10	−.18**	−.26***
Social-relatedness need	.24***	.05	−.12	−.17*	−.21**
Total needs satisfaction	.43***	.15*	−.13*	−.18**	−.27***
Perceived dental competence	.33***	.03	−.20**	−.20**	−.16*
RAI	.88***	.43***	−.11	−.39***	−.28***
Autonomous motivation	.87***	.83***	.43***	.10	−.31***
Controlled motivation	.13*	.54***	.92***	.71***	−.09
Anxiety for dental treatment	−.30***	.07	.24***	.13*	.07
Effort & quality of dental home-care	.36***	.21**	−.04	−.04	−.21**
Use of dental floss (frequency)	.35***	.20**	.01	−.09	−.26***
Teeth brushing (frequency)	.19**	.05	−.05	−.06	−.10
Fluor use (frequency)	.17*	.21**	.03	−.02	−.10
Dental behavior, total	.32***	.21**	−.01	−.07	−.21**
Dental health promotive behavior	.37***	.09	−.06	−.07	−.20**
Clinic attendance	.45***	.23***	−.01	−.11	−.28***
Putting off making a dental appointment	−.29***	−.03	.13*	.03	.14*
Gender	−.21**	−.15*	−.11	−.03	.13*
Age	.06	.07	.05	−.01	−.05

* $p < .05$; ** $p < .01$; *** $p < .001$ (two-tailed tests)

Fig. 1 Standardized parameter (regression) estimates depicting the relations in the structural SDT process model of dental behavior. *LISREL* analysis with a combination of latent and observed variables [χ^2 ($df = 143$, $N = 208$) = 301.98, $p < .001$; SRMR = .067; CFI = .96; IFI = .96; RMSEA = .073]. * $p < .05$; *** $p < .001$. *AS* autonomy support, *CS* controlling style, *CN* competence need, *AN* autonomy need, *SRN* social relatedness need
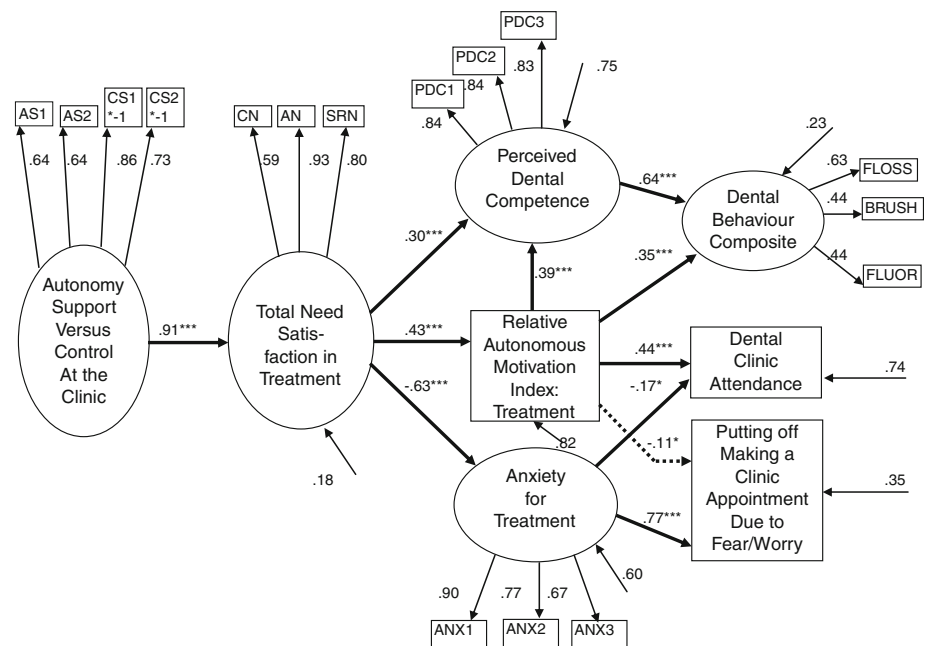

Fig. 1). The error variance for each observed variable (i.e., RAI, clinic attendance, and "putting off making a clinic appointment") was set to 15% of the squared standard deviation for each variable. The latent composite variable of autonomy supportive relative to controlling styles reflects the sum of 2 autonomy support items minus 2 controlling items. Because the three psychological needs were highly correlated we used them as indicators of total need satisfaction. In the evaluation of fit indices we used the same cutoff values as in the measurement model tested above of the Self-Regulation Questionnaire for Dental Treatment.

Table 5 Pearson correlations among variables ($N = 208$)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
1. Autonomy-support	–																			
2. Controlling style	-.57	–																		
3. Competence need	.47	-.50	–																	
4. Autonomy need	.65	-.60	.64	–																
5. Social-relatedness need	.63	-.62	.49	.75	–															
6. Total needs satisfaction	.68	-.67	.81	.92	.88	–														
7. Perceived competence	.36	-.38	.65	.43	.37	.55	–													
8. Relative Autonomy Index	.28	-.22	.55	.43	.29	.48	.40	–												
9. Autonomous motivation	.17	.03	.44	.30	.17	.35	.23	.79	–											
10. Controlled motivation	-.14	.34	-.14	-.15	-.16	-.18	-.25	-.25	.37	–										
11. Amotivation	-.29	.27	-.25	-.26	-.21	-.27	-.16	-.26	-.31	-.08	–									
12. Anxiety for treatment	-.33	.44	-.42	-.41	-.42	-.48	-.29	-.33	-.15	.23	.07	–								
13. Effort & quality, DHC	.32	-.22	.56	.31	.19	.40	.58	.38	.34	-.05	-.21	-.21	–							
14. Use of dental floss	.30	-.16	.43	.20	.08	.27	.42	.36	.33	-.04	-.26	-.20	.54	–						
15. Tooth brushing	.14	-.12	.30	.14	.03	.18	.38	.20	.14	-.06	-.10	-.14	.57	.34	–					
16. Fluor use	.11	.02	.27	.05	.07	.15	.27	.20	.22	.01	-.10	-.02	.35	.43	.14	–				
17. Dental behavior; Total	.25	-.12	.46	.17	.08	.27	.49	.34	.31	-.05	-.21	-.16	.66	.79	.69	.72	–			
18. DHPB	.43	-.34	.57	.51	.32	.54	.64	.37	.28	-.09	-.20	-.29	.54	.46	.33	.25	.47	–		
19. Clinic attendance	.31	-.23	.49	.31	.27	.41	.30	.46	.41	-.03	-.28	-.23	.34	.40	.09	.27	.34	.28	–	
20. Putting off making DCA	-.27	.33	-.33	-.38	-.36	-.42	-.23	-.30	-.20	.12	.14	.60	-.17	-.21	-.08	-.06	-.16	-.28	.32	–

$r \geq .13, p < .05; r \geq .18, p < .01; r \geq .23, p < .001$; two-tailed tests

DHPB dental health promotive behavior, *DCA* dental clinic appointment, *DHC* dental home care

Empirical models

Before we tested the structural model, the measurement model was tested with all variables and indicators depicted in Fig. 1 and found to fit the data well [χ^2 ($df = 176$, $N = 208$) $= 515.13$, $p < .001$; SRMR $= .078$; CFI $= .94$; IFI $= .94$; RMSEA $= .096$]. Modification indices suggested adding positive error covariances between the competence need and the dental behavior composite variable, and between two autonomy support items. These suggestions were evaluated as theoretically meaningful. The final measurement model yielded a good fit [χ^2 ($df = 175$, $N = 208$) $= 390.44$, $p < .001$; SRMR $= .050$; CFI $= .96$; IFI $= .96$; RMSEA $= .077$]. The structural model was tested with this measurement model included. The *a priori* structural equation modeling analysis for the SDT process model yielded a good fit [χ^2 ($df = 193$, $N = 208$) $= 428.82$, $p < .001$; SRMR $= .066$; CFI $= .96$; IFI $= .96$; RMSEA $= .077$]. This *a priori* structural model included all paths hypothesized in the theoretical model. All paths were significant, except that perceived dental competence was not significantly directly related to dental behavior and dental attendance, and relative autonomous motivation was not significantly directly related to effort and quality of dental home-care. The two motivation variables, perceived dental competence and relative autonomous motivation, were both bivariately significantly correlated in the expected directions with all 4 oral health-related variables (see Table 5). However, in the model test, each motivation variable predicted at maximum only two of the health-related outcomes directly. It is likely that this is caused by suppression due to a combination of substantial shared variance between the motivation variables, the relative strength of the correlations between these variables and the health-related variables, and in particular the strong correlation between effort/quality of dental home care and dental behaviors (see Table 5). Due to this, we simplified the structural model by omitting the effort/quality variable in the final model, and both perceived dental competence (standardized parameter estimate $= .64$, $p < .001$) and relative autonomous motivation (standardized parameter estimate $= .35$, $p < .001$) predicted significantly positively the dental behaviors, and thus, supported the suppression argument above. In addition, we omitted the non-significant links in this final model, and added the suggested modification indices of positive error covariances between the dependent measures of dental clinic attendance and the dental behavior composite, and between an autonomy support item and the social relatedness need. These suggestions were evaluated as theoretically meaningful. The final structural model yielded a good fit [χ^2 ($df = 143$, $N = 208$) $= 301.98$, $p < .001$; SRMR $= .067$; CFI $= .96$; IFI $= .96$; RMSEA $= .073$]. The standardized parameter estimates are shown in Fig. 1.

Two alternative structural models were tested. First, we changed the direction of influence in the model with perceived dental competence leading to relative autonomous motivation. This did not change the fit of the overall model and the strength of the links already observed in Fig. 1 did not change in any appreciable way. Second, we kept the model as illustrated in Fig. 1, but added amotivation to the model. The addition of amotivation did not improve the fit of the overall model and did not explain additional variance in the attendance or "appointment" variables. Specifically, total need satisfaction in treatment was negatively linked with amotivation (standardized parameter estimate $= -.32$, $p < .001$), whereas amotivation predicted neither dental clinic attendance (standardized parameter estimate $= -.07$, $p > .10$) nor putting off making a clinic appointment (standardized parameter estimate $= .03$, $p > .10$).

Mediation analyses

Mediations tested in the model appearing in Fig. 1 were done by the bootstrapping procedure described by Preacher and Hayes (2008). The results indicated that 8 of the 10 mediations (see Table 6) were significantly supported because the bias-corrected 95% confidence intervals (for the bands of products of coefficients after *n* re-samplings) did not include zero or oppositely valued coefficients. Relative autonomous motivation is a partial mediator because needs satisfaction still affected perceived competence in Fig. 1. This is expected because SDT proposes that needs satisfaction influences both perceived competence and autonomous motivation (Deci and Ryan 2000). Anxiety for treatment did not mediate the relation between need satisfaction and clinic attendance. Although anxiety for treatment is weakly negatively related to clinic attendance, it is relative autonomous motivation for treatment that most strongly is linked to clinic attendance. Relative autonomous motivation is also a stronger mediator than anxiety in the relation between need satisfaction and clinic attendance (see contrast 7–8 in Table 6). Perceived competence is also a stronger mediator than relative autonomous motivation in the relation between need satisfaction and dental behaviors (see contrast 5–6 in Table 6), and anxiety for treatment is a stronger mediator than relative autonomous motivation in the relation between needs satisfaction and putting off making a clinic appointment (see contrast 9–10 in Table 6).

Discussion

The results supported the SDT-based 5-factor model of motivation for dental treatment. This model included the integrated and identified types of autonomous motivation, and the introjection and external types of controlled

Table 6 Tests of mediations for the links emerging in Fig. 1

Independent variable (IV)		Mediator (M)		Dependent variable (DV)	Point estim.	SE	a*b-path Z	Bootstrapping BC 95% CI	
								Lower	Upper
1. Autonomy supportive relative to controlling style (ACS)	→	Needs satisfaction	→	Perceived competence	0.34	0.06	6.10***	0.24	0.44
2. ACS	→	Needs satisfaction	→	Relative Autonomous Mot. Index (RAI)	1.38	0.24	5.78***	0.96	1.83
3. ACS	→	Needs satisfaction	→	Anxiety for treatment	−0.17	0.04	−4.32***	−0.26	−0.10
4. Needs satisfaction	→	RAI	→	Perceived competence	0.10	0.04	2.71**	0.02	0.20
5. Needs satisfaction	→	Perceived competence	→	Dental behavior composite	0.17	0.03	5.34***	0.12	0.23
6. Needs satisfaction	→	RAI	→	Dental behavior composite	0.08	0.03	3.33***	0.04	0.13
7. Needs satisfaction	→	RAI	→	Clinic attendance	0.16	0.04	4.06***	0.10	0.23
8. Needs satisfaction	→	Anxiety for treatment	→	Clinic attendance	0.02	0.04	0.42	−0.06	0.10
9. Needs satisfaction	→	Anxiety for treatment	→	Putting off making clinic appointment	−0.21	0.04	−5.71***	−0.31	−0.12
10. Needs satisfaction	→	RAI	→	Putting off making clinic appointment	−0.05	0.03	−1.57	−0.10	−0.002
11. Contrast 5–6					0.09	0.04	2.25*	0.01	0.18
12. Contrast 7–8					0.14	0.06	2.39*	0.25	0.03
13. Contrast 9–10					−0.21	0.05	−4.38***	−0.32	−0.11

* $p < .05$; ** $p < .01$; *** $p < .001$

BC bias corrected; 5000 bootstrap samples, *a-path* IV → M, *b-path* M → DV

motivation, as well as amotivation. The relative autonomous motivation index of this new scale worked very well in testing the SDT process model of oral self-care behaviors and dental clinic attendance. Patients' perceptions of autonomy-supportive (relative to controlling) dental professionals at the clinic were positively associated with patients' psychological needs satisfaction in treatment, which was positively related to perceived dental competence and relative autonomous motivation for treatment, and negatively associated with anxiety for treatment. Perceived dental competence and autonomous motivation, in turn, were directly positively related to the dental behaviors. Relative autonomous motivation was directly positively linked to dental clinic attendance, and negatively related to putting off making a clinic appointment. Finally, anxiety for treatment, in turn, was directly negatively associated with clinic attendance, and directly positively linked to putting off making a clinic appointment. In addition to these significant paths, the fit indices indicated that the overall model fit the data well. Due to the relatively small sample size ($N = 208$), future research should obtain a second sample for confirmatory analyses of the Self-regulation Questionnaire for Dental Treatment and its predictive validity in relation to SDT-variables and dental behaviors.

This is the first study showing that both autonomy support (relative to control) at the dental clinic and patient

need satisfaction in treatment are negatively associated with anxiety for treatment, and positively associated with perceived dental competence and motivation for dental treatment. The findings are important because the strength of the correlations indicate that what happens to patients in treatment may substantially increase their motivation for dental treatment and strongly reduce their anxiety for treatment, both of which are associated with better dental health-related behaviors. The mediation analyses support this reasoning (see Table 6).

The relations between the two motivation variables, clinic contextual variables such as autonomy support and need satisfaction in treatment, and health-related outcomes are partly supported by two studies in the dental field (Halvari and Halvari 2006; Halvari et al. in press) and by SDT studies of attendance at a weight-loss program (Williams et al. 1996), diabetes self-management and improved glycemic control (Williams et al. 2004), and an intervention to promote tobacco cessation (Williams et al. 2006).

In the model, relative autonomous motivation lead to perceived competence. This direction of influence between the two variables is supported by other research (Kennedy et al. 2004; Williams et al. 2006). However, research also indicates the opposite direction of the link. An autonomy-supportive intervention produced simultaneously both perceived competence and autonomous motivation (with

the link to perceived competence being stronger), but perceived competence mediated the link between autonomy support and autonomous motivation in a subsequent test of the model (Halvari and Halvari 2006). Other intervention studies indicated that perceived-competence-related constructs changed first and affected change in motivation and behavior, with intrinsic motivation playing the stronger role in long-term change (Palmeira et al. 2007; Teixeira et al. 2006). These findings may be related to what is the more active components of the interventions, namely, contents intended to enhance either learning/competence or autonomous motivation? Theoretically, it may be difficult to develop competence without (self-) initiation of an activity. Conversely, it may be as problematic to chose and initiate an activity without knowing what to do or having the necessary competence. Thus, we tested the bi-directionality of this link in the present cross-sectional study, which was supported. Future research should evaluate which parts of interventions are the more salient, specifically, whether they related to autonomy, competence, or relatedness. This may be a first step toward clarifying this controversy.

In the model tested, we used the relative autonomous motivation index which includes two autonomous types and two controlled types of regulations. Amotivation is not a part of this index because it is a state in which people lack the intention to regulation their behavior. Correlations in Table 5 show that autonomous motivation shares more variance with the relative autonomy index than controlled motivation. In addition, autonomous motivation is significantly correlated with all behavior variables in the expected direction, whereas controlled motivation is weakly, but non-significantly, correlated with the behaviors in the opposite direction. This indicates that controlled motivation may not function separately in the SDT process model. However, controlled motivation does add to the predictive power of autonomous motivation when both types of motivation are included in the relative autonomous motivation index. Because amotivation was bivariately linked (−.28; see Table 5) to dental clinic attendance, it was included in an alternative test of the SDT process model illustrated in Fig. 1. This did not improve the fit of the model. Although amotivation was negatively linked to total need satisfaction in treatment, this non-intentional type of motivation was non-significantly related to the outcomes in the model. Thus, perceived dental competence, relative autonomous motivation in treatment, and anxiety for treatment are the most important mediators of the links between need satisfaction in treatment and the dental behaviors. In sum, these findings suggest that future interventions should focus more on autonomous than controlled types of regulations, because autonomous motivation is strongly correlated with other SDT-related variables and dental behaviors. In addition, it seems

important for treatments to focus on facilitating perceived dental competence and reductions of treatment anxiety.

Highly autonomy-supportive (relative to controlling) dental professionals, as perceived by patients, are strongly linked to patient need satisfaction in treatment, which is strongly negatively correlated with anxiety for treatment. This finding is supported by research indicating that patients' satisfaction and their anxiety reduction can be promoted by dentists' empathy, friendliness, competence support, and pain reduction (Corah 1988). This is similar to attributes of the biopsychosocial approach to patient care (Engel 1977), which is characterized by practitioners who are empathic, patient-centred, and sensitive to patients' psychological and social needs (e.g., Williams and Deci 1996).

Anxiety for treatment is much more strongly associated with putting off making a dental clinic appointment due to fear than it is related to dental clinic attendance (time since last visit). The latter finding corresponds with other research among Norwegian adults which indicated that anxiety for treatment explained a low proportion of the variance in dental attendance (Vassend 1993). This finding is also related to another study among Norwegian 25-year-olds indicating that about 40% of participants who were highly anxious for dental treatment had controlled their fear and visited a dental clinic regularly once a year during the last 5 years (Haugejorden and Klock 2000). Thus, anxiety for dental treatment predicts much stronger fear as the reason for putting off making a dental clinic appointment.

This is the first study linking relative autonomous motivation for treatment to dental clinic attendance, and demonstrating that motivation is a stronger mediator than anxiety for treatment in the relation between need satisfaction in treatment and dental clinic attendance (see Table 6). In addition, anxiety for treatment mediates strongly the negative link between need satisfaction and putting off making a dental clinic appointment due to fear. This is also a new finding. Thus, the functional significance of motivation and anxiety for treatment as mediators might be quite different in the relations of need satisfaction to the outcomes of clinic attendance and of putting off making a dental appointment. Future intervention research focussing on efforts to increase needs satisfaction in treatment is called for in order to test the hypothesis of subsequent reductions in anxiety for treatment, which should lead to reductions in putting off making clinic appointments.

SDT (Deci and Ryan 2000) hypothesize that autonomy-support and satisfaction of the needs for autonomy, competence and relatedness facilitate autonomous motivation and perceived dental competence, which both are crucial for healthy functioning. When working with relatively healthy and young people, the goals of health promotion and prevention of sickness are important goals for health care professionals. In the present study, we therefore

included a variable called "oral health promotion behavior" (OHPB) as a validating measure in relation to the SDT and health-related variables. The results showed that OHPB was significantly and relatively strongly related to all SDT-variables and health-related variables in the expected direction (see Table 5), thus indicating that SDT may be important for studying and understanding health promotion. However, in the structural model we chose to include measures specifically associated with more common oral health care behaviors.

In addition to supporting SDT (Deci and Ryan 1985, 2000), this is the first study linking autonomy support (relative to control) at the dental clinic and patient need satisfaction in treatment to motivation and anxiety for dental treatment, and to oral self-care behaviors and dental clinic attendance. Although the study has the limitations associated with being cross-sectional, the strength of the correlations does convey the importance of these relations. Still, correlation strength is not enough to infer causality. Rather, it is important to conduct more longitudinal studies, in where antecedent, mediator, and outcome variables being measured at different times, and/or randomized controlled trials in the dental field.

Appendix

The 9-item Basic Need Satisfaction in Dental Treatment Questionnaire based on the Basic Psychological Need Satisfaction in Exercise Scale (BPNES; Vlachopoulos and Michailidou 2006).

Items are back-translated to English from Norwegian and their factor loadings from confirmatory factor analysis are presented in parentheses and bold (OI = Original Item).

Participants responded to items following this stem: "When you are in treatment, how true or untrue are the following statements?"

Relatedness

I feel extremely comfortable when with the other exercise participants (OI).
I feel comfortable when I am with my dental professional **(.88)**.
I feel that I associate with the other exercise participants in a very friendly way (OI).
I feel that I and my dental professional associate in a friendly/pleasant way **(.94)**.
I feel very much at ease with the other exercise participants (OI).
I feel very much at ease with my dental professional **(.83)**.

Competence

I feel I have been making a huge progress with respect to the end result I pursue (OI).
I feel I have been making a huge progress with respect to my dental health goals **(.62)**.
I feel that I execute very effectively the exercises of my training program (OI).
I feel that I execute very precisely and well my dental care **(.78)**.
I feel that I can manage with the requirements of the training program I am involved (OI).
I feel that I can manage the requirements of my dental treatment **(.85)**.

Autonomy

I feel very strongly that the way I exercise fits perfectly the way I prefer to exercise (OI).
I feel very strongly that the treatment/examination fits perfectly the way I prefer it to be **(.88)**.
I feel that the way I exercise is definitely an expression of myself (OI).
I feel that the way I become treated/cared about at dental examinations is definitely an expression of my wishes **(.94)**.
I feel very strongly that I have the opportunity to make choices with respect to the way I exercise (OI).
I feel in a good way that I have the opportunity to make choices with respect to treatment/examination **(.81)**.

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